PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-219616
(43)Date of publication of application : 06.08.2002

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(51)Int.Cl.	B23G 5/06 B23P 15/28 B23P 15/52

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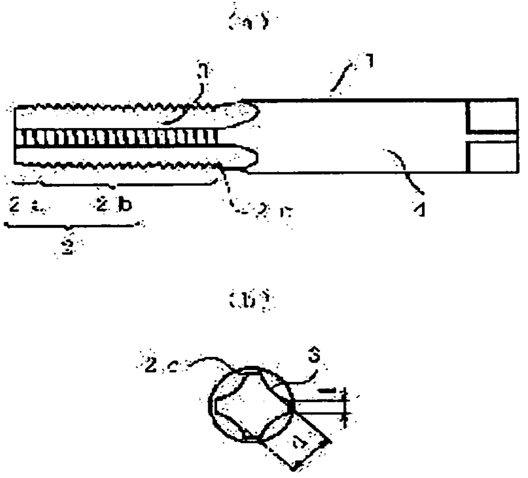
(54) TAP

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a tap for working a material hard to be cut such as a metal matrix composite(MMC) into a screw hole and remarkably improved in a service life thereof and formed into a shape hard to be broken by forming the tap into a shape capable of reducing the cutting resistance and forming a diamond film or a diamond-like carbon film hard to be peeled at a cutting part.

SOLUTION: The cutting blade part is formed of an imperfect thread shape chamfer part and a perfect thread shape screw part, and this cutting blade part is coated with the diamond film or the diamond-like carbon film. The cutting blade part is divided into four or more linear grooves in the circumferential direction, or the cutting blade part is provided with a spiral groove. Furthermore, a cutting angle of the cutting blade is set from -1 degree to -10 degree, desirably, from -3 degree to -5 degree.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

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CLAIMS

[Claim(s)]

[Claim 1] The aforementioned cutting-edge section is a tap which is divided [in / a circumferencial direction / have the cutting-edge section formed by the imperfection screw-thread Yamagata-like bevel lead and the completeness screw-thread Yamagata-like complete thread, and the diamond film or diamond-like carbon film covered by the front face of the aforementioned cutting-edge section at least, and] by the slot of the shape of four or more straight line, and is characterized by the bird clapper.

[Claim 2] The tap characterized by having the cutting-edge section formed by the imperfection screw-thread Yamagata-like bevel lead and the completeness screw-thread Yamagata-like complete thread, and the diamond film or diamond-like carbon film covered by the front face of the aforementioned cutting-edge section at least, and establishing a spiral-like slot in the aforementioned cutting-edge section.

[Claim 3] The rake angle of the aforementioned cutting edge is a tap according to claim 1 or 2 characterized by being -1 degree - -10 degrees.

[Claim 4] The rake angle of the aforementioned cutting edge is a tap according to claim 1 or 2 characterized by being -3 degrees - -5 degrees.

[Claim 5] The thickness of the aforementioned diamond film is a tap according to claim 1 or 2 characterized by being 5-20 micrometers.

[Claim 6] The thickness of the aforementioned diamond-like carbon film is a tap according to claim 1 or 2 characterized by being 1-20 micrometers.

[Claim 7] The tap according to claim 1 or 2 characterized by being for carrying out tapped hole processing of the metal machine composite.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the tap for processing unscrapable materials, such as a composite of a metal and ceramics, especially about the tap for processing a female screw.
[0002]
[Description of the Prior Art] In recent years, the metal machine composite (it is hereafter described as MMC) which is a composite of a metal and ceramics is used as a new material. It is expected that this material is broadly used compared with the conventional metallic material as a material of precision mechanical equipments, such as semiconductor fabrication machines and equipment, and a machine tool, a liquid crystal manufacturing installation, or equipment since a lightweight top and rigidity are high. When carrying out tapped hole processing to this material, a tap is used like the usual metallic material. Usually, about 20-30 pitches of complete threads of the portion whose tap is a cutting edge are prepared, in order to form the rake face of a cutting edge, the slot is prepared, for example, by the tap of M3-M10, four slots are prepared by three slots and more than M12. However, although a ceramic particle distributes MMC therefore, the tool wear by this ceramic particle is remarkable, and it is an unscrapable material very much. Therefore, tapped hole processing is not easy, either and it may also often happen that a cutting force becomes large and a tap breaks.
[0003] What MMC made [what] the aluminium alloy the matrix material and distributed ceramic particles, such as SiC, aluminum2O3, and AlN, in this is raised, and much pores may also exist in these. Although a drill performs prepared-hole processing before performing processing by the tap, it also often happens that a prepared hole bends in the case of an unscrapable material, and it gets, the ceramic particle is distributing as mentioned above, and since the hardness difference of a ceramic particle and a matrix material is large, a prepared hole tends to turn especially at MMC. Thus, if tapped hole processing is performed to the crooked prepared hole by the tap, the force in which it bends a tap will be applied and the problem of being further easy to break will occur.
[0004]
[Problem(s) to be Solved by the Invention] There is a tap indicated by JP,11-221716,A as a tap for performing tapped hole processing to MMC. This tap consists of a bevel lead whose cutting-edge section is an incomplete thread, and a complete thread in which the one or more pitch cutting edge of three or less pitch was formed, and covers a diamond film in this cutting-edge section. About the thickness of this diamond film, it is supposed by about about 2-3 micrometers that it is good.
[0005] However, since the cutting force is high in case tapped hole processing of MMC is performed, even if it is the above taps, there is a problem that a diamond film tends to separate, depending on the configuration of the cutting-edge section. If a diamond film separates, when [the cutting-edge section of a tap] especially a rake face side causes crater wear at an early stage and it stops acting as a cutting edge, a cutting force will become large further. And if this crater wear becomes large, it separates continuously, and a chip will weld, a cutting force will become still larger, and the problem that a tap breaks will also generate the diamond film of the flank of the cutting-edge section.
[0006] The above troubles are solved, when carrying out tapped hole processing of MMC, hard films, such as a diamond film, cannot separate easily, and this invention proposes the tap which cannot break easily.
[0007]
[Means for Solving the Problem] The 1st feature of the tap of this invention has the cutting-edge section formed by the imperfection screw-thread Yamagata-like bevel lead and the completeness screw-thread Yamagata-like complete thread, and the diamond film or diamond-like carbon film covered by the front face of the aforementioned cutting-edge section at least, and in a circumferencial direction, the aforementioned cutting-edge section is divided by the slot of the shape of four or more straight line, and is with a bird clapper.

[0008] Moreover, it is the cutting-edge section formed by the imperfection screw-thread Yamagata-like bevel lead and the completeness screw-thread Yamagata-like complete thread, and that have the diamond film or diamond-like carbon film covered by the front face of the aforementioned cutting-edge section at least, and the spiral-like slot was established in the aforementioned cutting-edge section as a feature of the tap of a configuration different from the above.

[0009] As the 2nd feature, the rake angle of the aforementioned cutting edge is having considered as -1 degree - -10 degrees.

[0010] It is having limited the rake angle of the aforementioned cutting edge further, and having considered as -3 degrees - -5 degrees as the 3rd feature.

[0011] As the 4th feature, it is having set thickness of the aforementioned diamond film to 5-20 micrometers.

[0012] As 4th another feature, it is having set thickness of the aforementioned diamond-like carbon film to 1-20 micrometers.

[0013] It is carrying out the aforementioned tap to tapped hole processing of a metal machine composite as the 5th feature.

[0014]

[Embodiments of the Invention] As the cutting-edge section, the bevel lead of an imperfect configuration is prepared at a nose of cam, and, as for the tap of this invention, the completeness screw-thread Yamagata-like complete thread is prepared succeeding this. This cutting-edge section is divided by the straight-line-like slot in the circumferencial direction, and, as for this slot, four or more numbers are prepared. The diamond film or the diamond-like carbon film is formed in the cutting-edge section by methods, such as a vapor phase synthetic method. As a material of a base material, cemented carbide is suitable. As for M3-M10, it is desirable that it takes 12 or more [four or more M] for five or more slots more preferably about the number of a slot.

[0015] For example, when processing it by the tap of M3, while a tap rotates one time, it will cut by four or more cutting edges. This cutting edge is made into four or more pieces for a diamond film or a diamond-like carbon film making it hard to make small the amount of cutting per cutting edge, and to separate. Moreover, if the amount of cutting of one cutting edge becomes small, the amount of a chip will also decrease, the size of a slot can also be made small, and even if a slot is shallow, the problem to which eccrisis of a chip becomes bad does not arise. Therefore, it can be made hard to be able to enlarge the path of the portion to which a path becomes thin most of a base material (d of drawing 1), and to break to the thrust at the time of tapped hole processing. In the case of a large material of a cutting force like MMC, this can especially perform an axial on-the-strength rise, and is effective in it. Furthermore, it is increasing a slot and shortening, the length (l of drawing 1), i.e., the land width, of a circumferencial direction of an edge, and it becomes easy to discharge a chip upwards and a cutting force also decreases. Thus, this invention persons found out that there was an effect beyond anticipation by increase of few paths.

[0016] Moreover, the configuration of the slot established in the cutting-edge section can also be made into the shape of a spiral as a configuration different from the above. If it is made the shape of a spiral, since there will be the eccrisis effect of the slot of the shape of an above-mentioned straight line and the chip more than equivalent and a slot can be made shallower, the path of the portion to which a path becomes thin most of a base material (d of drawing 1) can be enlarged further, and there is an effect also in the cure against breakage of a tap. In addition, when the discharge of a chip, the size of a slot, the diameter of the minimum of a base material, etc. are taken into consideration, carrying out to three or more is desirable.

[0017] About the rake angle of a cutting edge, it sets up among -1 degree - -10 degrees. - When biting at the time of cutting, by making it negative rake, making it 1 degree - -10 degrees secures edge-of-a-blade intensity, and it makes good surface grace of the processed tapped hole wall, without moreover reducing sharpness while a diamond film or a diamond-like carbon film makes it hard to separate. More preferably, although it is set as -3 degrees - -5 degrees, it is combination with the four or more above-mentioned slots, and when tapped hole processing of unscrapable materials, such as MMC, is performed, it can prevent effectively that a diamond film or a diamond-like carbon film separates.

[0018] Thickness of a diamond film is set to 5-20 micrometers. You may be 5 micrometers or more for a crack tending to enter during processing, since membranous intensity is weak when membranous thickness is thin, and resulting in ablation from there. Moreover, it is because it will be in the state where it was dotted with the particle of a diamond and does not become a film, even if it is going to form a less than 5-micrometer film depending on the membranous formation method. Although it is also possible to form a less than 5-micrometer diamond film by performing coitus with diamond powder etc., since the adhesion force with a base material becomes weak by this method and a diamond film becomes easy to separate, in a tool like this invention, it is unsuitable. If thicker than this, when R of the edge of a blade of the cutting-edge section will become large and an operation will fall as a cutting edge, you may be 20 micrometers or less for a film becoming easy to separate with the residual stress produced according to the difference

of the coefficient of thermal expansion of a base material and a film in case these films are formed.

[0019] Moreover, thickness in the case of forming a diamond-like carbon film is set to 1-20 micrometers. If it is required to be referred to as 1 micrometers or more in order to prevent that a base material is exposed and to maintain the cutting-edge function as a cutting tool at worst, when these films are worn out by cutting, and it is thicker than this to be referred to as 20 micrometers or less When R of the edge of a blade of the cutting-edge section becomes large and an operation falls as a cutting edge, it is for a film to become easy to separate with the residual stress produced according to the difference of the coefficient of thermal expansion of a base material and a film in case these films are formed.

[0020] When making into the shape of a straight line the configuration of a slot of dividing the cutting-edge section, it is desirable to consider as the shape of an parallel straight line to the shaft of a tap. While this is suitable to discharge scraps efficiently, processing of the base material of a tap becomes easy. When a workpiece is MMC like this invention, a chip is not the continuous thing and becomes a powdery thing. It is suitable if considering as the shape of a straight line takes the field of cost into consideration in order to discharge such a powdery chip.

[0021]

[Example] The tap of this invention is shown in drawing 1 . In addition, this example explains the tap of M3 to an example. What processed the configuration of drawing 1 was prepared using cemented carbide as a material of a base material 4. The cutting-edge section 2 is formed in the point of a base material 4. This cutting-edge section 2 makes [the threads per inch of bevel-lead 2a] 25 pieces the threads per inch of 10 degrees and complete-thread 2b to the shaft of a tap for the angle of four pieces and bevel-lead 2a, and the rake angle prepared three kinds, a -1 degree - -3 degrees thing, a -3 degrees - -5 degrees thing, and a -8 degrees - -10 degrees thing. The diamond film was formed in this cutting-edge section 2 by the vapor phase synthetic method, and thickness was set to about 15 micrometers. The slot 3 which divides the cutting-edge section 2 made the straight-line-like thing four.

[0022] As an example of comparison, the thing which carried out the rake angle within the limits of 3 degrees - 0 degree, and the slot 3 as show drawing 2 prepared three taps by the tap of the configuration shown in drawing 1 . The slot 3 prepared the -3 degrees - -5 degrees same thing as this invention, and the 3 degrees - 0 degree thing for the rake angle also about three taps.

[0023] Using these taps, tapped hole processing of MMC material was performed and the state where a diamond film exfoliated was tested. Composition of MMC material used what contains 30% of SiC particle in aluminum. It processed 100 holes at a time by each tap, and the number of the mountains where the diamond film exfoliated was measured. The result of these examinations is shown in Table 1.

[0024]

[Table 1]

	すくい角	溝数	剥離した山の数
本発明 1	-1°～-3°	4	2
本発明 2	-3°～-5°	4	0
本発明 3	-8°～-10°	4	2
比較例 1	3°～ 0°	4	6
比較例 2	-3°～-5°	3	6
比較例 3	3°～ 0°	3	9

[0025] The number of the mountains where what was made into the positive rake angle will exfoliate if the number of the mountains where, as for the tap of this invention, a diamond film exfoliates looks at the tap of the example of comparison to very few one as shown in Table 1 increases, and if the number of slots becomes three slots, its number of the mountains which exfoliate also in the time will increase. From the above thing, the tap of this invention has little exfoliation of a diamond film, and it leads to the reinforcement of a tap. In addition, although what covered the diamond film with this example was used, an effect with the same said of what covered the diamond-like carbon film is acquired.

[0026]

[Effect of the Invention] In case the tap of this invention performs tapped hole processing of an unscrapable material like MMC material, resistance concerning the cutting edge at the time of cutting can be reduced by using as the slot of the shape of four or more straight line, or a spiral-like slot the slot which divides the cutting-edge section, and as explained above, since sharpness is good, moreover, a diamond film or a diamond-like carbon film cannot separate

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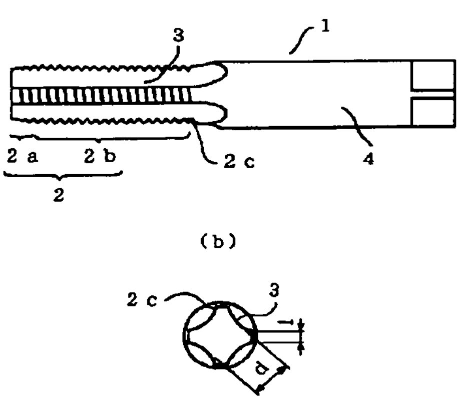
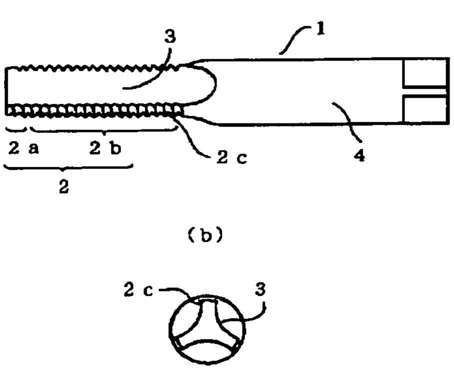
DRAWINGS

[Drawing 1]



[Drawing 2]



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